

Towards 100% Renewable Energy

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<https://coalition.irena.org/>

Setting the Scene: Brief Comments on the CfA
Working Group **Towards 100% Renewable
Energy Systems**

Renewable energy encompasses all renewable sources, including bioenergy, geothermal, hydropower, ocean, solar and wind energy. *One hundred percent renewable energy means that all sources of energy to meet all end use energy needs in a certain location, region or country are derived from renewable energy resources 24 hours per day, every day of the year. Renewable energy can either be produced locally to meet all local end-use energy needs (power, heating and cooling, and transport) or can be imported using supportive technologies and installations such as electrical grids, hydrogen or heated water. Any storage facilities to help balance the energy supply must also use energy derived only from renewable sources.*

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- Represents all end uses (e.g. Transport, Heating and Cooling); not just electricity sector
- However, the implication is that our energy demands will be met more and more by electrification
- 100% RE mean no carbon emissions at the source (no CCUS); different from “Net-Zero”

5 Scenarios Studied: 3 are 100% RE

100% RE →

← Net-Zero

ENERGY SYSTEM MODEL	GLOBAL 100% RE	1.5°C SCENARIO	100% WIND+ WATER-SOLAR (WWS)	1.5°C SCENARIO	NET-ZERO EMISSIONS (NZE)
Institution	LUT (2021)	UTS (2019)	Stanford (2022)	IRENA (2021)	IEA (2021)
Target(s)	100% renewable energy system by 2050	Achieving 1.5°C by 2050 with primary energy supply based on 100% renewable energy	80% WWS by 2030; 100% WWS by 2050 for 145 countries	Energy transition pathway aligned with the 1.5°C target (net zero by 2050)	Net zero by 2050
Renewable energy share in total energy supply (TES) by 2050	100%	100% (<92%, including non-energy consumption, which will still include fossil fuels. Primary energy supply in 2050 will be based on 100% renewable energy)	100%	44% in total energy supply (90% in electricity generation)	67% in total energy supply (88% in electricity generation)
Energy sources included in 2050	Solar photovoltaic (PV), concentrated solar power (CSP), wind, hydropower, geothermal and bioenergy	TPED: solar, wind, hydro, geothermal, biomass, ocean energy (tidal and wave), natural gas, oil, coal (latter due to non-energy consumption)	Generation: wind, solar PV, CSP, geothermal, hydro and ocean energy. Heat: solar thermal, geothermal heat	ES: solar, wind, biogas, biomass, hydropower, geothermal, solar, ocean energy, natural gas, oil, coal and nuclear	TES: solar, bioenergy, wind, hydropower, geothermal, other renewables, nuclear, natural gas, oil and coal.
2050 share of electricity (electrification level)	89% (total primary energy demand)	92.3% (total final energy demand)	Efficiency measures result in total energy demand decreasing by 56.4%, so that remaining energy is nearly all (-99.1%) electricity: 85% higher than 2018 actual levels (total installed capacity)	49% of direct electricity in total final energy consumption and 14% from hydrogen	49% of electricity in total final energy consumption
Cumulative investment needed to 2050	USD 72 trillion, noting net energetic yield per invested unit of capital in renewable electricity solutions far exceeds the one in upstream fossil fuels	USD 51 trillion across the power sector (an average investment of USD 1420 billion per year, 2015-2050) USD 12.4 trillion for the heating sector (an average investment of USD 344 billion per year, 2015-2050)	Around USD 61.5 trillion Upfront costs are recovered through energy sales, covering WWS electricity; heat and green hydrogen generation; storage for electricity, heating, cooling and green hydrogen; district heating heat pumps; all-distance transmission; and distribution	USD 131 trillion Annual funding requirement averaging USD 4.4 trillion), adapted from planned government cumulative energy and energy related infrastructure investment strategies amounting to USD 98 trillion by 2050	Annual average capital invested is indicated for 2030-2040-2050: - 40-50 trillion USD, annual investments of 4-5 trillion per year by 2030 - Almost USD 5 trillion annually by 2040 - USD 4.5 trillion annually by 2050
Job creation	134 million by 2050 in the global energy sector*	478 million energy-sector jobs by 2050 (up to 89% would be renewable energy jobs by 2030)	28.4 million (net increase) by 2050	22 million jobs in the global energy sector; 43 million directly in renewable energy 25 million in power grids and flexibility 25 million in energy efficiency - 2-4 million in hydrogen	30 million more people under NZE working in clean energy, efficiency and low-emissions technologies.

Source: IRENA CfA: 100% Renewable Energy Scenarios

- “Net-Zero” still includes use of fossils for our energy supply; not 100%
- Technologies largely exist to achieve 100%
- Total cost of energy transformation generally much lower for 100% than for net-zero
- Political will and financing still needed

- 1) Embrace 100% RE; Phase-out Fossil Fuels
- 2) Prioritize Energy Efficiency
- 3) Expand Electrification
- 4) Upgrade to a resilient, decentralized, and flexible energy system
- 5) Foster International Cooperation

- **Transport** (esp. shipping, aircraft, commercial vehicles)
- **Heating and Cooling** (esp. high temperature industrial heat)
- **Electricity** (esp. Grid flexibility and reliability, digitization and security)